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R. W. Macqueen and R. A. Olson

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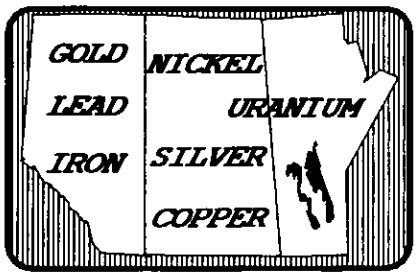
Articles



Metallic Mineral Potential, Western Interior Platform and Underlying Precambrian: Introduction

R.W. Macqueen
Institute of Sedimentary and Petroleum Geology
Geological Survey of Canada
3303 – 33rd Street N.W.
Calgary, Alberta T2L 2A7

R.A. Olson
Trigg, Woollett, Olson Consulting Ltd.
10504 – 103 Street
Edmonton, Alberta T5H 2V4

Are there more lead-zinc deposits of the calibre of Pine Point elsewhere in the relatively undisturbed Phanerozoic rocks of the Interior Platform? What is the bearing of karst development and evaporite solution on the metallic mineral potential of the Phanerozoic rocks? What is the potential for gold, copper, uranium, or other metals in these rocks? Are positive features such as the Peace River Arch and the Sweetgrass Arch of particular interest, although buried? Could epithermal precious metal deposits be associated with such deep-seated, long-lived structures or, possibly, the Sweetgrass Intrusives? What metallic mineral deposits might be expected in Precambrian rocks at shallow depths beneath Phanerozoic cover rocks, and by what techniques and approaches can such buried Precambrian rocks be evaluated?

Rationale

These and related questions underlie the one-day session on Metallic Mineral Potential of the Western Interior Platform and underlying Precambrian rocks, held at the Geological Association of Canada (GAC) — Mineralogical Association of Canada (MAC) Joint Annual Meeting in Saskatoon in May 1987. The original ideal and enthusiasm for the session originated with Reg Olson, who enlisted Roger Macqueen as co-organizer. Co-sponsored by the Mineral Deposits Division of GAC and by the Canadian Society of Petroleum Geologists, the session was so well received that the organizers and participants decided to prepare short papers summarizing their presentations, and, most importantly, include key references of value to those interested in mineral exploration in this vast and largely untapped region of our country. From the fourteen papers given at the session, there are eleven summary papers included here, and three abstracts.

General and Conceptual Papers

The first four papers have implications for mineral explorationists considering the Interior Platform and shallow Precambrian rocks of the entire region. Because Interior Platform sedimentary successions essentially are flatlying, this is an area of very limited outcrop, with a thin to thick veneer of unconsolidated Quaternary deposits. Mark Fenton's paper considers the kinds and sources of data available on the Interior Platform Quaternary deposits, offers some insights into the nature, origin and history of the deposits, and comments on exploration strategy. A full list of references is included. Frank Simpson's contribution deals with the nature of, and the effects related to, localized solution removal of bedded salt deposits of the platform. As his maps clearly illustrate, solution-generated collapse structures in overlying strata are widespread and are important at present in providing conduits for cross-formational fluid flow. How far back in time have these systems operated, and have they served to localize metal-bearing brines of the type that formed Mississippi Valley-type (MVT) lead-zinc deposits similar to those at Pine Point? There is much scope here for research and exploration!

The Interior Platform contains a number of basement-related positive features whose origin is poorly understood. The existence and behaviour of these features undoubtedly governs the occurrence of hydrocarbon deposits and may also control the location of metallic mineral deposits. Jim Podruski's contribution compares and contrasts two of the most important of such features, the Peace River and Sweetgrass Arches, based mostly on the wealth of subsurface data that is available for the Western Canada Basin.

What of the Precambrian rocks at shallow depths beneath Phanerozoic cover? Bruce Blair, Werner Weber, Les Kornik and Terry Gordon's summary of Project Cormorant shows how much can be learned from an integrated approach involving a range of geophysical surveys along with study of adjacent outcropping Precambrian rocks and all available diamond drill core. The goal of this work was to trace the subcrop (sub-Phanerozoic succession) of the Flin Flon-Snow Lake greenstone belt and surrounding Precambrian rocks. The work results from a co-operative Mineral Development Agreement project negotiated by the governments of Canada and Manitoba, an approach that is certainly applicable elsewhere in the prairie provinces. It is significant that the Namew Lake nickel-copper deposit, briefly reviewed here in an abstract by Jim Pickell of Hudson Bay Mining and Smelting, occurs within the sub-Phanerozoic Flin Flon greenstone belt in Manitoba, within the area of Project Cormorant. Discovery of this deposit in April 1984 followed a five-year search for such deposits that was conducted largely in advance of the Project Cormorant study. Pickell (*pers. comm.*, 1987) regards the prospects for additional similar deposits as excellent.

Regional Papers

Seven papers provide a regional survey of prospects and potential for three prairie provinces, northeastern British Columbia, and the southernmost Northwest Territories. Although the approaches taken by authors differ somewhat from area to area, all papers offer basic data, suggestions on how to proceed, and useful references. Beginning with Manitoba, George Gale and co-workers H.R. McCabe and E. Nielsen consider the

prospects for uranium and base metal mineralization in the relatively thin and very poorly exposed (< 0.5%) Paleozoic succession of southern Manitoba. Indications appear favourable, but there is a profound lack of data.

For the province of Saskatchewan, Doug Paterson has considerably more data to work with, and presents a brief review of gold, uranium, manganese, copper, zinc, lead, iron and mercury in a wide variety of settings in Phanerozoic rocks and sediments and the shallow Precambrian rocks beneath them. Paterson's list of metallic occurrences is encouraging, although none are economic at present. One possibly promising carbonate-hosted lead-zinc occurrence in Saskatchewan Middle Devonian rocks is reviewed by Campeau and Kissin (project WAPA). This occurrence was discovered accidentally within a drilling program whose purpose was to assess coal deposits within the Cretaceous Mannville Group.

Dixon Edwards summarizes the metallic mineral situation for Alberta. Mineral production there for 1986 represented half the Canadian total, although 93% of Alberta's dollar value of production was due to petroleum and coal, with industrial minerals making up the balance. Edwards briefly reviews metallic mineral potential in the four major regions of Alberta: the exposed and shallow buried Precambrian Shield basement, the Proterozoic Athabasca Basin, Rocky Mountains and Foothills west of the Interior Platform, and the Interior Platform itself. Once again there are favourable indicators at least locally, but no economic metallic mineral discoveries. Edwards suggests that the Alberta situation perhaps should be viewed as an undeveloped opportunity rather than as a lack of geologic potential. Marc Dubord reviews the factors to be considered in assessing the prospects for Mississippi Valley-type lead-zinc mineralization in Paleozoic rocks of northeastern Alberta. Are the factors governing the origin of Pine Point repeated in Alberta? Dubord asks the question, but only time and effort will provide an answer.

Faced with a lack of Interior Platform metallic mineral data for the BC Interior Platform, JoAnne Nelson and Don MacIntyre's review focusses on the metallic deposits of the deformed belt, some types of which might occur in the platform. Perhaps the deposit type with the most potential in platform rocks in British Columbia is carbonate-hosted (or MVT) lead-zinc sulphides. The numerous known surface (Rocky Mountains) and subsurface lead-zinc showings occur at Middle Devonian stratigraphic levels, and tend to follow carbonate-shale transitions. The other deposit types they discuss appear to be confined to the deformed belt and to be related to long-lived crustal rifts, but the lack of data prevents definite conclusions from being drawn.

Walter Gibbins points out that to date all of the metallic mineral production from the platform within the southern Northwest Territories has come from 48 of the 100 identified MVT lead-zinc deposits that are present in the Pine Point district. Similar geological conditions are present around the west end of Great Slave Lake, but the lack of exploration success in this area tends to suggest a uniqueness for Pine Point. However, as elsewhere in the platform, the size of the area and the relatively limited exploration yield no definitive answer to the question of whether features indicative of another Pine Point exist elsewhere. Precambrian rocks at shallow depths in the Northwest Territories have potential for a variety of base and precious metals, but it may take a Namew Lake – Project Cormorant style exploration program or study to begin to assess the potential.

Three papers are represented by abstracts. Jim Pickell briefly reviews the Namew Lake nickel-copper discovery, a Flin Flon greenstone belt copper-nickel deposit located beneath 6 metres of water and 40 metres of Ordovician dolomite and sandstone (Pickell, *pers. comm.*, 1987). Brian Hitchon, on the basis of numerical modelling techniques based in part on observed formation water chemistries of Western Canada basin samples, suggests that cooling and dilution of lead and zinc-bearing formation waters could bring about changes in metallic species favouring sulphide precipitation. Grant Mossop reports on progress to mid-1987 on plans to produce a new atlas of the subsurface geology of the Western Canada Basin, a project now taking shape and planned for completion by 1991. The original atlas (McCrossan and Glaister, 1964) remains a landmark document, and is still in constant use by anyone wishing to obtain a quick grasp of regional stratigraphy of this large area.

Summary

What did we learn from the special session? The data in the papers included here indicate the following:

1. There are a considerable number of diverse mineral occurrences, and geological, geochemical or geophysical anomalies, within Phanerozoic rocks of the Interior Platform and Precambrian rocks of the adjacent outcropping and immediately subcropping Precambrian basement.
2. Some of the geological anomalies are deep-seated, long-lived structures such as the Peace River Arch, Sweetgrass Arch and McDonald Fault System. There are also a number of local structural phenomena such as the Lake St. Martin and Steen River circular structures in Manitoba and Alberta respectively, and a large number of actual or inferred faults in flatlying Phanerozoic strata of southern Alberta and Saskatchewan. Are these settings host for metallic mineralization?
3. Perhaps the highest potential in this vast region may be for carbonate-hosted lead-zinc deposits, because there exist:
   (a) diverse carbonate lithologies and facies relationships;
   (b) karst collapse structures;
   (c) warm to hot potentially mineralizing fluids with above background contents of lead and zinc;
   (d) a number of minor lead-zinc occurrences in addition to the major orebodies of the Pine Point lead/zinc district.
4. Potential may also exist for:
   (a) epithermal gold deposits associated with structures and/or intrusives such as the Sweetgrass Intrusives;
   (b) gold or other heavy precious metals in placer or paleoplacer settings;
   (c) sandstone-type uranium occurrences in Mesozoic and Tertiary clastics or basal Phanerozoic rocks;
   (d) rare earths, uranium or other commodities associated with heretofore unrecognized carbonatite or breccia pipes. These are seemingly absent from the Western Interior Platform but are known to occur locally in other Phanerozoic interior platforms of the world, including the Colorado Plateau of Arizona, and northern Baffin Island of the Northwest Territories.

Topics lightly treated to untreated here include detailed structural studies based on the range of techniques from satellite photography to closely spaced boreholes; present fluid flow patterns including the significance of fracture hydrology; and present heat flow distribution and patterns. All of these are interrelated and all may provide significant data to formulate or guide future sophisticated metallic mineral and hydrocarbon exploration programs in this enormous region.

We thank all authors for their contributions, and hope that our editorial changes have not obscured their basic messages of curiosity and enthusiasm tempered by the realization of how little we really know about the Canadian Western Interior Platform, an area approximately the size of the whole of western Europe.